Technical Approaches to Restore Impaired Waterbodies within the Non-tidal Passaic River Basin

New Jersey Department of Environmental Protection
Watershed Management Program
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In May 1999, the New Jersey Department of Environmental Protection (Department) and USEPA Region II entered into a Memorandum of Agreement including an 8-year schedule to produce Total Maximum Daily Loads (TMDLs), as necessary, for all water quality limited segments remaining on the 1998 Section 303(d) List of Water Quality Limited Waterbodies in New Jersey or provide information necessary to remove waterbodies from the list. A TMDL represents the assimilative or carrying capacity of receiving water, taking into consideration point and nonpoint sources of pollution, natural background and surface water withdrawals. A TMDL is developed as a mechanism for identifying all the contributors to surface water quality impacts and setting goals for load reductions for specific pollutants as necessary to meet surface water quality standards. TMDLs are required, under Section 303 (d) of the federal Clean Water Act, to be developed for waterbodies that cannot meet surface water quality standards after the implementation of technology-based effluent limitations.

This paper discusses the current status of chemical water quality impairments within the non-tidal[1] Passaic River basin, as well as the technical approaches the Department is pursuing to address those impairments. The Whippany River, one of the major watersheds within the Passaic River basin, was the subject of a pilot watershed management effort that culminated with a fecal coliform TMDL, a Total Phosphorus Reduction Plan, and an amended MOA with USEPA Region II dated March 2000 through which metals and biological listings are being addressed. Biological impairments in rivers, eutrophic lakes, and fish consumption advisories throughout the non-tidal Passaic River basin will be addressed through separate technical approach documents.

For several years, the Department has been working with the Passaic River TMDL Work Group (TMDL-WG) to develop technical approaches to addressing impairment listing in the non-tidal Passaic River basin. The primary purpose of this paper is to memorialize the current outcome of those ongoing discussions to develop TMDLs and other management responses as discussed below. In November, 2000, the Department and Rutgers University through the New Jersey EcoComplex (NJEC) entered into a MOA whereby NJEC will provide the Department technical support as necessary to assure the successful completion of TMDL modeling in New Jersey watersheds. The secondary purpose of this paper, therefore, is to further the cooperation between the Department and NJEC regarding TMDL modeling activities in the non-tidal Passaic River basin.

[1] Dundee Dam is the tidal / non-tidal demarcation for the Passaic River.

I. Current Status of Pollutants of Concern

In accordance with section 303(d) of the federal Clean Water Act, the Department prepared New Jersey's 1998 list of water quality limited waterbodies. Section 303(d) of the federal Clean Water Act requires New Jersey to identify waters that are not attaining or not expected to attain water quality standards after the implementation of technology based effluent limits. The most recent list of impaired waterbodies was published by the Department in September, 1998 as *Identification and Setting of Priorities for Section 303(d) Water Quality Limited Waters in New Jersey* (www.epa.gov/owow/tmdl/).

New Jersey's 303(d) List divides water quality characteristics for waters in New Jersey into two categories. Part 1 lists waters where impairments of water quality are known or where exceedances are based on conventional pollutants and fecal coliform, fish consumption advisories and shellfish harvesting restrictions, and 22 eutrophic lakes. Part 2 lists waters with evidence of water quality concerns but without sufficient information to characterize the waterbody as a "known water quality limited segment." Such waters lack extensive data or the existing data indicates that further analysis is warranted. Heavy metals and un-ionized ammonia are within this suspected category, along with 500 sites with biological impairment, and about 100 lakes with less detailed data. However, these waters are still considered impaired and will undergo supplemental monitoring to confirm impairment and to develop appropriate management responses.

A. total phosphorus ("Known Water Quality Impairments")

The following waterbodies (see Figure 1) were identified based on EPA guidance for development of Water Quality Inventory Reports (305b), which recommends comparison of data collected within the last 5 years to applicable New Jersey Surface Water Quality Standards (SWQS). If greater than 10% of samples exceed criteria, the waterbody is identified as "not fully meeting designated uses" in Water Quality Inventory Report and is a candidate for 303d listing. Data collected 4-6 times per year in the DEP-USGS Cooperative Ambient Stream Monitoring Network were used as the basis for Passaic Basin conventionals listings.

- Whippany River @ Morristown (discussed in separate TMDL Report)
- Whippany River near Pine Brook (discussed in separate TMDL Report)
- Passaic River near Millington
- Passaic River near Chatham
- Passaic River @ Two Bridges
- Passaic River @ Singac
- Passaic River @ Little Falls
- Passaic River @ Elmwood Park
- Pompton River @ Packanack Lake
- Ramapo River near Mahwah
- Pequannock River @ Macopin Intake
- Wanaque River @ Wanaque
- Rockaway River @ Boonton
- Rockaway River @ Pine Brook

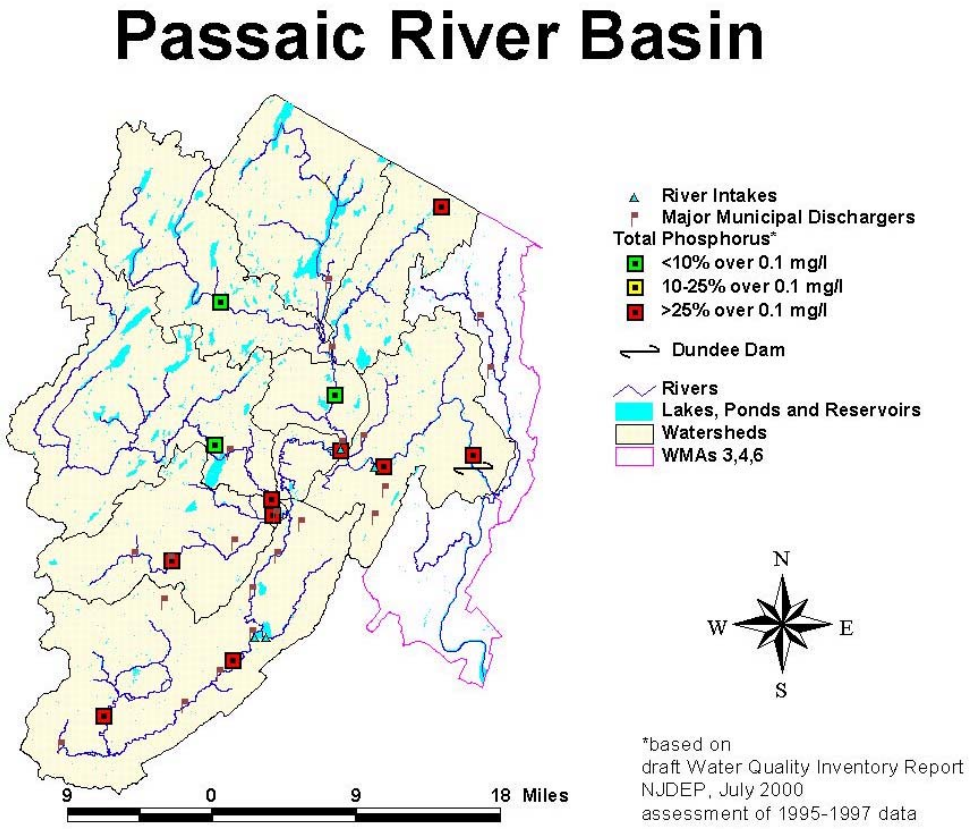

Figure 1

In order to prevent excessive primary productivity and consequent impairment of recreational, water supply and aquatic life designated uses, the SWQS require that total phosphorus in all freshwater streams and lakes not exceed 0.1 mg/l and 0.05 mg/l, respectively, unless it can be demonstrated that phosphorus is not a limiting nutrient and will not otherwise render the waters unsuitable for the designated uses. In addition, Nutrient Policy #2 in the SWQS requires that: *Except as due to natural conditions, nutrients shall not be allowed in concentrations that cause objectionable algal densities, nuisance aquatic vegetation, or otherwise render the waters unsuitable for the designated uses.*

In order to generate the 1998 303(d) List, however, the threshold of 0.1 mg/l was used without regard to nutrient limitation or use impairment because phosphorus is typically limiting in natural freshwater systems. Based on chemical and algal biostimulation information, however, it appears that for most of the occurrences in the Passaic River basin when phosphorus concentrations exceed 0.1 mg/l, phosphorus is not a limiting nutrient. In these situations, it is important to evaluate whether designated uses (i.e. aquatic life, water supply or recreation), which are protected under Nutrient Policy #2, are affected by excessive primary production. It is also important to consider that excessive primary production may occur primarily in depositional areas such as impoundments and under summer low flow and drought conditions. Excessive primary production may be manifested as blooms of floating algae (seston), attached algae

(periphyton) or dense aquatic vegetation, which in turn affect diurnal oxygen dynamics. At this time, it is not clear whether excessive primary productivity is rendering unsuitable the aquatic life (e.g. fish, benthos) or recreational uses in the river systems.

Near the Borough of Pompton Lakes, the Ramapo River slows down and widens as it flows into Pompton Lake, a privately accessed lake. The Ramapo River intake for the Wanaque Reservoir is located in Pompton Lake. On the Ramapo River just downstream of the dam that causes Pompton Lake, there exists a long-term flow and water quality monitoring station (Ramapo River at Pompton Lakes) that very likely reflects water quality in Pompton Lake as well. While phosphorus concentrations upstream in the Ramapo River near Mahwah are much higher, it is Pompton Lake that shows evidence of excessive primary productivity such as oxygen supersaturation. The worst episodes of supersaturation occur during nitrogen limitation, likely due to a shift in algal composition, and while total phosphorus concentration is less than 0.1 mg/l. Nevertheless, it appears that phosphorus management is needed at this location.

In addition to the primary and secondary recreational and aquatic life designated uses, freshwaters (classified FW2) are also designated as public potable water supplies, after conventional filtration treatment and disinfection. Conventional filtration treatment consists of a series of processes including filtration, flocculation, coagulation and sedimentation, resulting in substantial particulate removal but no consistent removal of chemical constituents. There are several water supply intakes within the non-tidal Passaic River Watershed.

The Wanaque Reservoir, located in the northern portion of the non-tidal Passaic River basin, was not listed as impaired on the 1998 303(d) List. However, phosphorus concentrations above the 0.05 mg/l criterion have been observed in the reservoir, along with episodes of excessive undesirable algae concentrations. This public water supply draws water directly from the Ramapo and the Pompton Rivers into the reservoir, which is pumped near the outlet and treated for potable uses. Under certain pumping and flow conditions, the Wanaque South pumping station on the Pompton River draws phosphorus-rich Passaic River water upstream a short distance into its intake. Because of the water supply intakes in the Ramapo and Pompton Rivers, phosphorus in downstream rivers has environmental consequences upstream in the Wanaque Reservoir, namely excessive production of undesirable algae. For this reason, the Department is focussing near-term TMDL efforts on the Wanaque Reservoir. Additional investigation of other reservoirs, such as Canoe Brook, should also be undertaken.

A related issue is the high total phosphorus concentrations in the Passaic River at Little Falls, the only place where river water is withdrawn directly into a drinking water treatment plant. Water quality at Little Falls does not appear to be highly impacted by excessive primary production, and phosphorus does not appear to be limiting algal growth at that location. However, elevated phosphorus concentrations sharply increase demand for coagulant. Costs to treat drinking water with elevated phosphorus increase much more than linearly, due to secondary costs associated with management of increased sludge quantities. These costs are borne by the recipients of Passaic Valley Water Commission drinking water, and yet the high concentrations of phosphorus are caused largely by discharges from point sources that accumulate as water travels downstream in the watershed. In this context, the high phosphorus concentrations at Little

Falls is a watershed problem that must be addressed on a watershed basis in order to ensure safe drinking water quality and develop cost-effective management strategies for drinking water treatment and wastewater disposal. In addition to cost implications, there may be a threshold of total phosphorus concentration over which coagulation, and therefore drinking water quality, is compromised. Such a threshold could serve as a site-specific criterion to protect the existing water supply use.

An evaluation of ambient stream monitoring network (ASMN) data from 1995 to 1999 show that the Pequannock and Wanaque Rivers have phosphorus concentrations consistently lower than the 0.1 mg/l threshold, as does the Rockaway River at Boonton. About 10% of samples from the Pompton River exceed 0.1 mg/l. These exceedances do not occur during peak algal activity periods, nor during periods of oxygen supersaturation. The Whippany, Rockaway (downstream of Boonton), Passaic, and Ramapo Rivers all exceed 0.1 mg/l in more than 10% of the samples. The Department will evaluate all existing and readily available data collected within the last five years and will pursue de-listing phosphorus at locations where the numerical criterion is met.

The Department is working to clarify the relationship between nutrient policies, nutrient criteria and designated use attainment. Assessments of oxygen dynamics, primary production, sedimentation, and downstream impacts will be used as appropriate to evaluate the current and future needs for phosphorus management in the non-tidal Passaic River basin. As needed, the Department will develop site-specific nutrient criteria to address confirmed designated use impairments.

B. fecal coliform ("Known Water Quality Impairments")

- Whippany River @ Morristown
- Whippany River near Pine Brook
- Passaic River near Millington
- Passaic River near Chatham
- Passaic River @ Two Bridges
- Passaic River @ Singac
- Passaic River @ Little Falls
- Passaic River @ Elmwood Park
- Rockaway River @ Boonton
- Rockaway River @ Pine Brook
- Pompton River @ Packanack Lake
- Ramapo River near Mahwah
- Wanaque River @ Wanaque

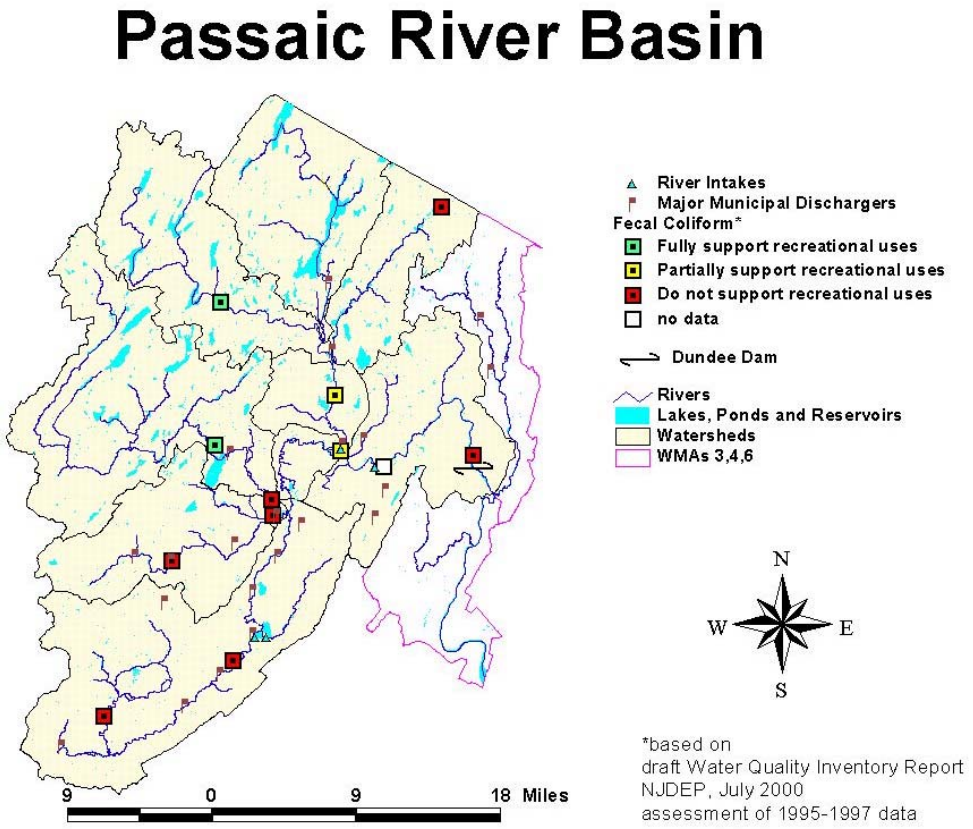

Figure 2

In order to protect primary contact uses (i.e., swimming), the SWQS require that the 30-day geometric mean of fecal coliform counts, as measured in at least 5 samples over a month time period, not exceed 200 FC/100ml and not more than 10% of the samples can exceed 400 FC/100ml. Waters that meet both components of the criteria are considered to fully support recreational uses; waters that meet one component partially support recreational uses; waters that do not meet either component do not support recreational uses. Waters that do not fully support recreational uses are considered impaired (see Figure 2).

ASMN data from 1995 to 1999 confirm most of the fecal coliform impairments on the 1998 303(d) List. With the exception of the upstream portions of the Rockaway, Pequannock, and Wanaque Rivers, the Passaic mainstem and major tributaries exceed the fecal coliform criteria. The Whippany River will continue to be listed for fecal coliform even though a TMDL has been completed because the criteria are not met yet. In addition, many sites included after 1998, when implementation of the redesigned Ambient Stream Monitoring Network began, also do not meet fecal coliform criteria and will be candidates for listing in 2002. Management measures will be required to address these impairments.

C. dissolved oxygen ("Known Water Quality Impairments")

- Whippany River near Pine Brook
- Passaic River near Millington
- Passaic River @ Two Bridges
- Wanaque River @ Wanaque

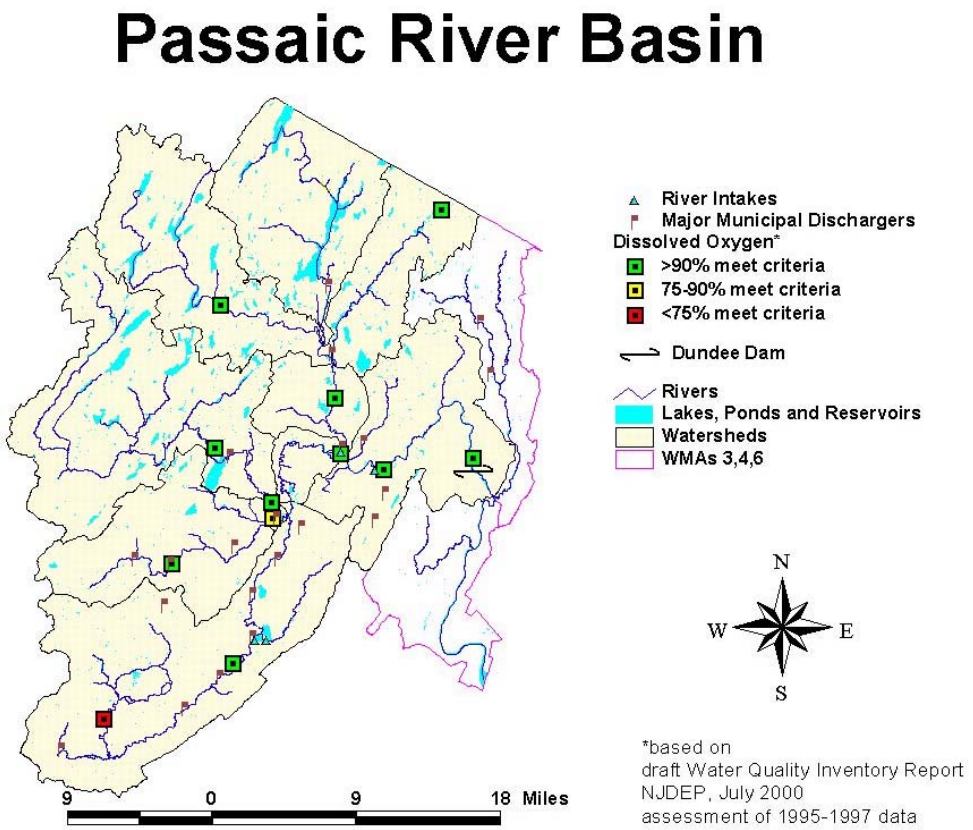

Figure 3

The SWQS define dissolved oxygen criteria in terms of minimum thresholds that vary according to stream classification. Generally, low dissolved oxygen can be caused by one or both of the following:

- excessive oxygen-demanding substances exposed to the water column, usually expressed as biological oxygen demand, nitrogenous oxygen demand, and/or sediment oxygen demand; and/or
- excessive primary production, leading to oxygen deficits in the pre-dawn hours when respiration and decomposition are not overshadowed by photosynthesis.

Secondary treatment of municipal wastewater has greatly reduced the occurrence of oxygen depletion caused by excessive oxygen-demanding substances. The ASMN is also much more sensitive to this type of oxygen depletion, since measurements are taken during the day when temperatures, and therefore decomposition rates, are highest. The same monitoring network can be insensitive to oxygen depletion caused by excessive primary production, if data collected during the day are only compared against minimum

thresholds and not oxygen saturation values. During the day, streams experiencing excessive primary production will often be supersaturated with oxygen (e.g., 120% dissolved oxygen saturation or greater) due to the increased photosynthetic rates. Streams that are supersaturated during the day will often be depleted by the pre-dawn after a whole night of respiration and decomposition without the offsetting effect of dissolved oxygen production through photosynthesis. Currently, diurnal dissolved oxygen data are being collected for 3 consecutive days during the growing season at a subset of sites in the ASMN which were selected based on exceedances of dissolved oxygen criteria, elevated or depressed percent dissolved oxygen saturation.

ASMN data from 1995 to 1999 show no new impairments for dissolved oxygen in the Passaic River basin (see Figure 3). None of the oxygen results at any location in the Wanaque River was below the applicable criteria. At the Passaic River at Two Bridges, less than 10% of the oxygen results were below the applicable criteria. The Department will consider all existing and readily available data collected within the last five years to develop the 2002 Impaired Waterbodies List. If these data show criteria are met, the Department will pursue de-listing for dissolved oxygen.

Greater than 10% of the oxygen results at the Whippany River near Pine Brook were below the applicable criteria. This has warranted placing the Whippany River near Pine Brook on Category 5 of the integrated list. In addition, episodes of supersaturation during the same time period indicated the need for diurnal or pre-dawn oxygen sampling. Diurnal data collected in the Whippany River near Pine Brook, recently published by USGS, indicate the criterion was met. It should also be noted that the DO exceedances on the Whippany River occur downstream of the Troy Meadows wetlands complex and that extensive sampling upstream performed as part of the Whippany river study did not shown any exceedances of the criterion. This indicates that a solution to the DO exceedences should take into account the effects of the Troy Meadows wetlands complex on the Whippany River.

About 25% of the oxygen results in the Passaic River near Millington did not meet the applicable criterion. However, this upstream site is located in a Category 1 water that is heavily influenced by the Great Swamp wetlands. In addition, there are three point sources above this site, including one with compliance issues, necessitating additional data and source investigations. If subsequent investigations confirm that dissolved oxygen criteria are not met, results will be used to determine the need for TMDLs.

D. pH ("Known Water Quality Impairments")

- Rockaway River @ Pine Brook
- Pequannock River @ Macopin Intake

ASMN data from 1995 to 1999 demonstrate full compliance with pH criteria at both locations. The Department will consider all existing and readily available data collected within the last five years to develop the 2002 Impaired Waterbodies List. If these data show criteria are met, the Department will pursue de-listing for pH.

E. sodium ("Known Water Quality Impairments")

- Ramapo River near Mahwah

Levels above finished drinking water Maximum Contaminant Levels (MCLs) were used to list this waterbody for sodium. However, no sodium criterion exists in the SWQS. The Department will evaluate data collected within the last 5 years to evaluate impairments to drinking water uses.

F. temperature ("Known Water Quality Impairments")

- Pequannock River @ Macopin Intake

ASMN data from 1995 to 1999 demonstrate full compliance with the temperature criteria in the Pequannock River at Macopin Intake. However, the Pequannock River Coalition's diurnal temperature sampling data have registered temperature exceedances to warrant keeping the Pequannock River on Category 5 of the Integrated List. If it is shown that other pollution control measures can result in full attainment, a TMDL would not be necessary and the Pequannock would be moved to the Category 4 Integrated List.

G. un-ionized ammonia ("Suspected Water Quality Impairments")

- Whippany River near Pine Brook
- Passaic River @ Two Bridges
- Passaic River @ Little Falls

ASMN data from 1995 to 1999 demonstrate full compliance with the un-ionized ammonia criteria at all locations on the 1998 303(d) List. The Department will consider all existing and readily available data collected within the last five years to develop the 2002 Impaired Waterbodies List. If these data show criteria are met, the Department will pursue de-listing for un-ionized ammonia.

H. metals ("Suspected Water Quality Impairments")

Background

The locations below were included on the 1998 303(d) List for one or more of the following metals: arsenic, beryllium, cadmium, chromium, copper, iron, lead, mercury, nickel, selenium, silver, thallium, and zinc:

- Whippany River
- Rockaway River
- Passaic River
- Pompton River
- Pequannock River
- Ramapo River

Metals listings in the freshwaters of Passaic Basin and throughout the state were generated primarily from two information sources: the 1990 Assessment of Waters Impaired by Toxic Pollutants (NJDEP, 1990) also known as the 304(l) List and NJDEP-USGS Cooperative Ambient Stream Monitoring Network (ASMN). There were several concerns associated with metals listings which include the comparison of total recoverable metals data to dissolved criteria; historical use of sample collection and analyses procedures that, while acceptable at the time, were less rigorous than current procedures; and lack of current evaluations of waters identified in the 1990 304(l) list

based on water quality and effluent data collected in the early to mid-1980's. In addition, metals were monitored less frequently than conventionals (2 samples every 3 years), so fewer data points were available for listing decisions. Therefore the nature and extent of metals listings on the 1998 303(d) list may be overstated.

The Interagency 303d Technical Workgroup developed a procedure for metals to determine if waterbodies could be de-listed or should be retained for the 2002 New Jersey Impaired Waterbodies List. This workgroup includes representatives from NJDEP, USEPA Region II and USGS. The workgroup piloted the procedure in Whippany Watershed as per the USEPA Region 2 and NJDEP Memorandum of Agreement for TMDL development. The pilot procedure was then applied to all streams included on the 1998 Impaired Waterbodies List for metals. The Whippany Pilot is summarized on Attachment 1.

The procedure includes an evaluation of metals concentrations under baseflow and elevated flow conditions. All data were collected using approved Quality Assurance Project Plans and will be available through EPA's STORET database. The Interagency 303d Technical Workgroup defined "baseflow" as "flows that are less than long term daily median flow and less than 30% change from the previous day". "Elevated flow" was defined as "flows that are 10% or more above long term daily median flow".

Baseflow data were collected under a special sampling effort called 303d Evaluation Monitoring (or 303d Reconnaissance Monitoring). Total recoverable (TR) and dissolved fraction (DF) metals were collected for 3 consecutive days under baseflow conditions. Samples are collected using modified Clean Methods sample collection techniques and analyzed in the New Jersey Department of Health and Senior Services (NJDHSS) certified laboratory.

Available elevated flow data were extracted from the NJDEP-USGS Cooperative Ambient Stream Monitoring Network (ASMN) using total recoverable metals data collected in the last 5 years (i.e., since 1996). Samples were collected using improved sampling techniques and are analyzed at the USGS National Water Quality Laboratory in Denver, Colorado. If at least 1 elevated flow sample was not available, or applicable SWQS criteria were not met, new TR and DF metals data will be collected under elevated flow in the 303d Evaluation Monitoring Program and analyzed at the NJDHSS laboratory.

SWQS criteria for metals include human health (HH), acute aquatic life (AQLa) and chronic aquatic life (AQLc). See N.J.A.C. 7:9B. HH criteria are based on TR form of the metal. Most AQL criteria are based on DF form of the metal; exceptions are AQLc for mercury and AQL for selenium. AQL criteria for cadmium, copper, lead, nickel, silver and zinc were calculated based on hardness at the time of sampling. To the extent available, TR and DF data were compared to TR and DF criteria, respectively. Note that only TR data are collected in the Ambient Stream Monitoring Network. However, TR concentrations above DF criteria triggers additional sampling, not TMDL development.

In some cases, the analytical method detection limit (MDL) was higher than the applicable criteria (i.e., concentrations at or below the criterion were not measurable). This occurred for arsenic (MDL: 1 ppb, HH criterion: 0.017 ppb); mercury (MDL: 0.04 ppb, AQLc criterion: 0.012 ppb). Depending on hardness, AQLc criteria for cadmium,

copper and lead were also not measurable in some samples. If metals concentrations above the MDL were found, an exceedence was identified. If metals concentrations were reported as "less than MDL", the metal will be retained on the 2002 Impaired Waterbodies List and analyses with lower detection limits will be sought. TMDL development will not be undertaken unless an exceedence is documented.

De-listing will be pursued in the 2002 303(d) lists if the following conditions are met:

1. Criteria are measurable: The applicable criterion, calculated using hardness at the time of sampling as appropriate, is measurable (i.e., the Method Detection Limit (MDL) is below the applicable criterion).
2. Criteria are met under baseflow: The 3 TR and DF samples have concentrations that are below the applicable criteria under baseflow;
3. Criteria are met under elevated flow: The 1 or more elevated flow samples have concentrations that are below the applicable criteria.

Preliminary 2002 Impaired Waterbodies List for Passaic Basin Metals

In the Passaic River basin, the 303d Evaluation Monitoring baseflow sampling was performed in the fall of 1997, spring of 1998 and again in the spring of 2000. The 1997 and 1998 sampling was considered a pilot because only a subset of listed metals were sampled at many locations, sampling was not conducted for 3 consecutive days and some quality assurance issues arose as the field and lab Clean Methods techniques were implemented for the first time. Therefore, more weight was given to the 2000 data in the assessment provided below. ASMN data collected within the last 5 years were screened to identify samples collected under elevated flow conditions.

The results are summarized below to provide a preliminary indication of 2002 Impaired Waterbodies List decisions. This assessment is preliminary because: additional elevated flow data are being collected at several sites; NJDEP is accepting data for the development of the 2002 Impaired Waterbodies List through November 21, 2001; and the Draft 2002 Impaired Waterbodies List will undergo an extensive public review and must be approved by USEPA. Therefore, the preliminary recommendations provided below may be amended.

Beryllium and iron will be de-listed in the Passaic Basin and statewide because there are currently no criteria for these metals in the New Jersey SWQS.

<u>Whippany River</u>

As discussed above, the Interagency 303d Technical Workgroup conducted a pilot analysis of metals in the Whippany River, which is described in detail in Appendix A.

The 1998 New Jersey Impaired Waterbodies List (i.e., 303d List) included the following listings for metals in the Whippany River: Arsenic, Cadmium, Chromium, Copper, Mercury. (see NJDEP, 1998 page A58). Data from the Whippany River at Morristown and Pine Brook were used to evaluate this listing.

Criteria for arsenic (HH), cadmium and mercury (AQL-c) were below analytical MDLs. These metals will be retained on the 2002 Impaired Waterbodies List and analytical methods with lower MDLs will be pursued.

For metals with criteria above analytical MDLs, applicable criteria were met in the Whippany River at Morristown and Pine Brook under baseflow conditions in 1998 and 2000. For metals with criteria above analytical MDLs, ASMN data collected under elevated flow in the Whippany River indicated that all criteria were met except lead at Pine Brook. New elevated flow data will be collected at this station. De-listing will be pursued in 2002 if new elevated flow data, in addition to baseflow data, are below applicable criteria. In addition, new elevated flow data will also be collected at Morristown to facilitate TMDL planning.

Rockaway River

The Rockaway River is listed for Arsenic, Beryllium, Cadmium, Chromium, Lead, Mercury, Selenium and Zinc (see NJDEP, 1998, page A60). Data from the Rockaway River at Boonton and Pine Brook were used to evaluate this listing. There were quality assurance issues associated with the 303d Evaluation Monitoring data collected in 1997. Therefore the results presented below are based on data collected in 2000.

Criteria for arsenic (HH), cadmium and mercury (AQL-c) were below analytical MDLs. These metals will be retained on the 2002 Impaired Waterbodies List and analytical methods with lower MDLs will be pursued.

For metals with criteria above analytical MDLs, applicable criteria were met in the Rockaway River at Boonton and Pine Brook under baseflow conditions in 2000. ASMN data collected under elevated flow were not available for the Rockaway River at Boonton. For metals with criteria above analytical MDLs, ASMN data collected under elevated flow in the Rockaway River at Pine Brook indicated that all criteria except lead were met. New elevated flow data will be collected for the Rockaway River at Boonton and Pine Brook. De-listing will be pursued in 2002 if elevated flow data, in addition to baseflow data, are below applicable criteria.

Passaic River (headwaters to Two Bridges)

This portion of the Passaic River is listed for Arsenic, Cadmium, Chromium, Copper, Lead, Mercury, Silver and Zinc (see NJDEP, 1998, page A59). Data from the Passaic River at Millington, Chatham and Two Bridges were used to evaluate this listing.

Criteria for arsenic (HH), cadmium and mercury (AQL-c) were below analytical MDLs; other aspects of cadmium and mercury criteria were met. These metals will be retained on the 2002 Impaired Waterbodies List and analytical methods with lower MDLs will be pursued.

For metals with criteria above analytical MDLs, results from baseflow sampling conducted in 2000 indicate applicable criteria were met in the Passaic River at Millington, Chatham and Two Bridges except arsenic at Two Bridges. ASMN data collected under elevated flow were not available for these stations. New elevated flow data will be collected for in the upper Passaic River.

Arsenic will be retained on the 2002 Impaired Waterbodies List in the Passaic River at Two Bridges. For other metals, de-listing will be pursued in 2002 if new elevated flow data, in addition to baseflow data, are below applicable criteria.

Passaic River (Little Falls to Elmwood Park)

This portion of the Passaic River is listed for Arsenic, Cadmium, Chromium, Copper, Lead, Mercury, Silver, Thallium and Zinc (see NJDEP, 1998, page A61). Data from the Passaic River at Little Falls, Singac and Elmwood Park were used to evaluate this listing.

Criteria for arsenic (HH), mercury (AQL-c) for all samples and cadmium (AQL-c) at Little Falls in 2000 were below analytical MDLs; other aspects of these criteria were met. These metals will be retained on the 2002 Impaired Waterbodies List and analytical methods with lower MDLs will be pursued.

For metals with criteria above analytical MDLs, results from baseflow sampling indicate applicable criteria were met at Little Falls, Singac and Elmwood Park in 2000. ASMN data collected under elevated flow were not available for these stations. De-listing will be pursued in 2002 if elevated flow data, in addition to baseflow data, are below applicable criteria.

Pompton River

The Pompton River is listed for Arsenic, Cadmium, Copper, Iron, Lead, and Mercury (see NJDEP, 1998, page A62). Data from the Pompton River at Packanack Lake were used to evaluate this listing.

Criteria for arsenic (HH), cadmium and mercury (AQL-c) were below analytical MDLs. These metals will be retained on the 2002 Impaired Waterbodies List and analytical methods with lower MDLs will be pursued.

For metals with criteria above analytical MDLs, applicable criteria were met in the Pompton River at Packanack Lake under baseflow conditions. ASMN data collected under elevated flow in the Pompton River at Packanack Lake indicated all applicable SWQS criteria were met except lead. New elevated flow data will be collected for the Pompton River at Packanack Lake. If elevated flow data are also below applicable criteria, de-listing will be pursued in 2002.

Pequannock River

The Pequannock River is listed for Copper and Lead (see NJDEP, 1998, page A63). Data from the Pequannock River at Macopin Intake Dam were used to evaluate this listing.

The criterion for lead (AQL-c) was below the analytical MDL; other aspects of the criteria were met. Lead will be retained on the 2002 Impaired Waterbodies List and analytical methods with lower MDLs will be pursued.

For copper, the criteria was above analytical MDLs, and applicable criteria were met in the Pequannock River at Macopin Intake Dam under baseflow conditions in 2000. ASMN data collected under elevated flow in the Pequannock River at Macopin Intake Dam indicated all applicable SWQS criteria were met. Therefore, copper de-listing will be pursued in 2002.

Ramapo River

The Ramapo River is listed for Arsenic, Chromium, Lead and Mercury (see NJDEP, 1998, page A63). Data from the Ramapo River at Mahwah were used to evaluate this listing. Lead data were collected in 1997, and data for all metals were collected in 2000.

Criteria for arsenic (HH) and mercury (AQL-c) were below analytical MDLs; other aspects of these criteria were met. These metals will be retained on the 2002 Impaired Waterbodies List and analytical methods with lower MDLs will be pursued.

For metals with criteria above analytical MDLs, applicable criteria were met in the Ramapo River at Mahwah under baseflow conditions in 1997 (lead only) and 2000 (all listed metals). ASMN data collected under elevated flow in the Ramapo River at Mahwah indicated all applicable SWQS criteria were met. Therefore, de-listing will be pursued in 2002.

Next Steps

Elevated flow data collection for these sites will be conducted in a cooperative project between USEPA Region II, NJDEP and USGS. Through the NEPPS Performance Partnership Agreement, USEPA Region II agreed to collect samples under elevated flow in the Passaic Basin and elsewhere in the state. USGS will provide flow data. Samples will be analyzed by NJDHSS laboratory and results will be analyzed by NJDEP. Ideally, results will be available for the 2002 Impaired Waterbodies List, but will otherwise be used for the 2004 list.

For metals which cannot be de-listed because concentrations at or below the criteria were not measurable, efforts are underway to identify certified laboratories that can provide analytical MDLs below the applicable SWQS criteria.

For metals with concentrations above the applicable criteria, additional data will be needed to identify sources which contribute to the elevated concentrations. Sources may include point sources; non-point sources include new inputs from stormwater, resuspension of bottom sediments and contaminated sites. As discussed in Attachment 1, results of "cause analyses" conducted for point sources by the Division of Water Quality will be used to evaluate point source contributions. In addition, the Department has requested assistance from the NJEC to develop a monitoring and assessment plan to evaluate non-point sources.

I. cyanide ("Suspected Water Quality Impairments")

- Passaic River near Millington
- Passaic River near Chatham

Information from NJDEP's 304(l) Report provided the basis for these listings. The Department will obtain data and evaluate before taking any management measures to address cyanide.

J. trichloroethylene and tetrachloroethylene ("Suspected Water Quality Impairments")

- Rockaway River

Information from the Department's 1990 304(l) Report provided the basis for these listings. Baseflow data collected in 1997 show trichloroethylene and tetrachloroethylene levels below applicable SWQS criteria. Since these contaminants arise from point sources or contaminated ground water leaching to surface water, maximum concentrations would be expected under baseflow conditions. Therefore, de-listing will be pursued in 2002.

K. nitrate

In order to protect drinking water uses, the SWQS criterion for nitrate in fresh waters is 10 mg/l, based on the MCL for safe drinking water. Additional monitoring of finished drinking water is required if nitrate levels above 5 mg/l are found.

None of the surface waters in the Passaic River basin are listed as impaired by nitrate because there are no documented exceedances of the SWQS for nitrate. In addition, the nitrate MCL in finished drinking water from Passaic basin water supplies continues to be met. Nevertheless, nitrate has been identified as an emerging issue in the 2000 New Jersey Water Quality Inventory Report due to elevated maximum concentrations and increasing trends at ASMN stations. Nitrate levels have exceeded 5 mg/l on several occasions during low-flow events and, based on a USGS study of water quality trends between 1986 and 1995, concentrations appear to be increasing at some locations in the Passaic basin.

Since conventional drinking water treatment does not remove nitrate and nitrate poses an acute human health risk, source water nitrate concentration is critical. The Passaic River at Little Falls is the critical location for nitrate in the Passaic River basin, being the only place where river water is withdrawn directly into a drinking water treatment plant.

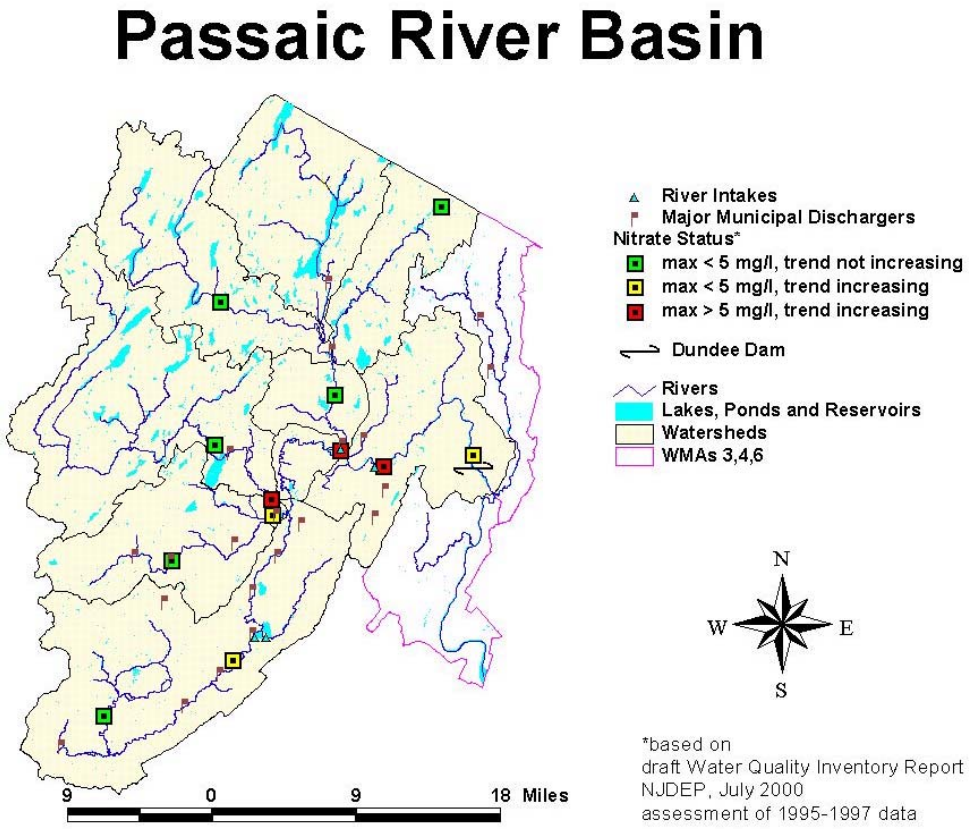

Figure 4

ASMN data from 1995 to 1999 indicate that mean nitrate levels increased from 2.59 mg/l to 2.99 mg/l and peak nitrate concentration increased from 5.50 mg/l to 7.90 mg/l between 1995-1997 and 1998-1999 (see Figure 4). Nitrate data taken during this period at Little Falls indicate an upward trend of between 0.14 and 0.27 mg/l/yr. The Passaic River at Little Falls is near the location of the intake for the Passaic Valley Water Commission's water treatment plant.

L. total nitrogen

Total nitrogen has been identified as a critical pollutant of concern responsible for areas of oxygen depletion in the New York / New Jersey Harbor. Consequently, the TMDL for the Harbor, scheduled for 2005, will include a load allocation for total nitrogen in the Passaic River at Dundee Dam. The load allocation for the Passaic River at Dundee Dam (tidal to non-tidal demarcation) will have to be converted to specific load allocations and wasteload allocations in the non-tidal Passaic River basin. Such an exercise amounts to a TMDL for the non-tidal Passaic River basin, with the end point being a specific loading rate in the Passaic River at Dundee as determined by the load allocation from the Harbor.

II. Technical Approaches

A. Total Phosphorus / Nutrients

1. Wanaque Reservoir TMDL

While the Wanaque Reservoir is not listed as an impaired water, pumping of phosphorus-rich waters from the Ramapo, Pompton and Passaic Rivers into the Wanaque Reservoir causes phosphorus concentrations to exceed 0.05 mg/l, the criterion specified in the SWQS to protect aquatic life, recreation and drinking water uses in reservoirs from excessive primary productivity. A TMDL for the Wanaque Reservoir would determine the maximum rate of phosphorus loading into the Wanaque Reservoir from all sources that could be allowed while still maintaining acceptable water quality in the reservoir.

Three technical tasks are required in order to develop a phosphorus TMDL for the Wanaque Reservoir. The first two tasks can occur simultaneously, and must be completed before the third.

- The first task is to quantify the relationship between phosphorus loading rates into the Wanaque Reservoir and resultant water quality in the reservoir. LA-WATERS is a two-dimensional hydrological and water quality model of the Wanaque Reservoir. Originally developed to predict the impact of the Wanaque South diversion on reservoir water quality,[2] LA-WATERS was recently re-verified for the Department.[3] It successfully reproduced pumping and water quality conditions that occurred from 1991 through 1998. By quantifying the relationship between phosphorus loads and resultant reservoir water quality, LA-WATERS fulfills the requirements for the first task.

  North Jersey District Water Supply Commission (NJDWSC) expressed concern that although LA-WATERS was re-verified using data through 1998, it may not be able to simulate extreme drought conditions that occurred in 1999. In response to their concern, the Department agrees to re-run LA-WATERS using 1999 conditions.

- The second task is to develop one or more water quality objectives (quantifiable end points) for the reservoir that will protect designated uses. As a starting point, the SWQS specify a total phosphorus criterion of 0.05 mg/l for all reservoirs to protect aquatic life uses from excessive primary production. Site-specific criteria could be developed in one of several ways by:

  - defining excessive primary productivity in the Wanaque Reservoir using a response variable such as chlorophyll-a or dissolved oxygen instead of the causal variable total phosphorus;

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[2] Huang, P., T. Najarian, and V.K. Gunawardana. 1988. *Influence of Wanaque South Diversion on the Trophic Level of Waanque Reservoir and its Water Quality Management Program*. Prepared by Najarian & Associates, Inc. for North Jersey District Water Supply Commission and Hackensack Water Company.

[3] Najarian Associates. 2000. *Water Quality Assessment of the Upper Passaic River Watershed and the Wanaque Reservoir*. Prepared for New Jersey Department of Environmental Protection.

  - ensuring that 0.05 mg/l of total phosphorus in the reservoir is the right concentration to protect against excessive primary production in the Wanaque Reservoir; or
  - defining, using one of the two previous approaches, a level of primary production in the reservoir that is protective of drinking water uses.

- The third technical task is to develop and test, using the tool from Task 1, management scenarios to achieve the water quality objective(s) specified in Task 2. A range of management scenarios to reduce phosphorus loading rates must be considered, including changes to water supply and wastewater discharge operations as well as nonpoint source reduction efforts. The performance of this task requires the use of LA-WATERS.

It is important to recognize that the Wanaque Reservoir TMDL will result in allocations of load from all significant sources, including the river intakes. In order to translate the intake allocations into load and wasteload allocations in the rivers, separate tools are needed to calculate backwards through the riverine system. Such an exercise will amount to another TMDL in the river, with the end points being specific loading rates at the intakes as determined by the Wanaque Reservoir TMDL. The flow model described below in section A4 is intended to provide the foundation necessary for water quality modeling in the river. Insight gained from the projects described below in sections A5 and A6 will be used along with other available information to construct appropriate water quality models for the Passaic and Pompton riverine systems.

The Department recommended and the TMDL-WG agreed on October 31, 2001 that a proposal should be solicited from Najarian & Associates to perform this work since they developed LA-WATERS and are therefore uniquely qualified to do so.

NEXT STEPS

- Request proposal from Najarian & Associates through NJEC to apply LA-WATERS to perform calculations necessary to develop a phosphorus TMDL for the Wanaque Reservoir. The contractor will:
  - ✓ run LA-WATERS using 1999 data and compare with available monitoring results;
  - ✓ work closely with the Department and the TMDL-WG to develop one or more water quality objectives (quantifiable end points) for the reservoir that will protect designated uses and that can be calculated using LA-WATERS;
  - ✓ work closely with the Department and the TMDL-WG to develop scenarios to meet the water quality objectives; and
  - ✓ run scenarios necessary to perform TMDL calculations.

2. Pompton Lake and Ramapo River TMDL

The water quality at the monitoring station on the Ramapo River at Pompton Lakes is likely to have similar water quality to Pompton Lake, since it is near the outlet of the lake. Data from this monitoring station indicate that the total phosphorus criterion for lakes, 0.05 mg/l, may be exceeded, although data collected within the lake are needed to

evaluate this assumption. Pompton Lake appears to be the most sensitive component around which a TMDL could be developed. Data are needed to better understand and quantify the primary productivity issues in the lake. The fact that the Ramapo River flows into Pompton Lake can be used to greatly simplify the TMDL. Sediment recycling and continuous mixing in the lake make the total phosphorus load over time much more important than the concentration of influent stream at any given time. It is possible that an empirical analysis relating annual load to long-term mean concentration could be used to develop a TMDL for Pompton Lake, depending on the strength of the correlation between loading and concentration. Such an analysis could be used to trigger regulatory phosphorus reduction efforts quickly. A longer-term effort to model nutrient and algal dynamics in Pompton Lake may also be necessary.

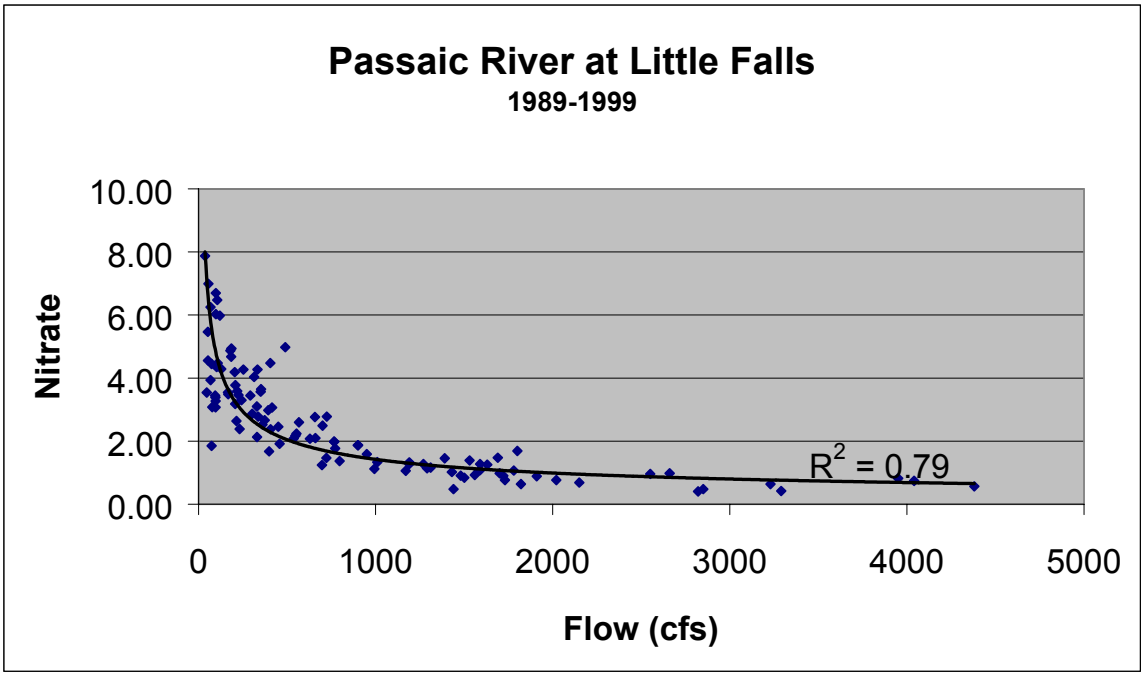
A lake restoration plan must be developed to address specific water quality objectives in the lake. Such a plan may include a phosphorus TMDL if necessary but would also consider other remedial measures such as suitable plant introduction and protection, nutrient removal (including sediments), and biomanipulation of fish community.

NEXT STEPS

- Request proposal through NJEC to evaluate existing information and data on Pompton Lake and influent watershed to:
  - ✓ better characterize the lake, including (to the degree information exists) the morphology, hydrology, chemistry, biology, sediment dynamics and primary productivity in the lake;
  - ✓ apply existing information to quantify the various sources of phosphorus load into Pompton Lake;
  - ✓ determine whether data exist to support an empirical relationship between load and concentration, and if so, the strength and nature of that relationship;
  - ✓ identify data and research gaps required to develop a lake restoration plan.

3. Nitrate at Little Falls

As shown below, nitrate concentrations in the Passaic River at Little Falls are strongly associated with flow; higher flows dilute the nitrate down to less than 1 mg/l, while



concentrations above 5 mg/l have occurred during extreme low flow events. Nutrient loads in the Passaic River at Little Falls, especially during low to moderate flows, are dominated by discharges from major municipal sewage treatment plants.

Before considering possible management responses to address the issue of nitrate concentrations in the Passaic River at Little Falls, it is important to consider other Departmental activities that may affect nitrate concentrations this location:

1. The NY/NJ Harbor Estuary Program anticipates establishing a TMDL for the Harbor by 2005 to address dissolved oxygen impairments. Preliminary results using the System-Wide Eutrophication Model (SWEM) indicate that a load allocation for total nitrogen will be imposed on the Passaic River at the system boundary, which is the tidal/non-tidal demarcation at Dundee Dam. A TMDL for total nitrogen upstream of Dundee Dam will be necessary in order to implement the load allocation at that location from the Harbor TMDL.
2. In order to satisfy provisions in N.J.A.C. 7:14A-13.5, the Division of Water Quality has been revising permits to include reporting requirements for nitrate. When sufficient data are reported pursuant to the revised permits, dilution analyses will be performed to determine whether, in the absence of any other nitrate sources, individual discharges will cause an exceedance of the 10 mg/l criterion during design flow conditions. The design flow for non-carcinogenic human health criteria such as nitrate is MA30CD5 (minimum average 30 consecutive day flow with a statistical recurrence interval of five years). If it is determined that an individual discharge will cause an exceedance of the criterion during design flow conditions, an appropriate effluent limitation will be imposed. Such an effluent limitation does not constitute a TMDL, since it does not consider background sources, others point sources, or nonpoint sources.
3. The Department currently implements anti-degradation provisions in the SWQS for point sources through the permitting process. The discharger provides an anti-degradation study to show that the discharge will not cause water quality to exceed the 95% confidence interval of the mean water quality. The mean water quality is determined through a water quality study conducted in accordance with a work plan approved by the Department.
4. The Department is conducting the Source Water Assessment Program; additional nitrate data collected in source water, throughout drinking water treatment plants and in finished drinking water under requirements of the Federal Information Collection Rule are expected to become available through this program. The Source Water Assessment Program findings and recommended nitrate management measures, if any, should be considered.

The Department in consultation with the TMDL-WG considered several possible management responses to address nitrate concentrations in the Passaic River at Little Falls:

1. A proactive TMDL for nitrate could be established to prevent excessive nitrate loads from impairing the drinking water use. Generally, TMDLs are considered remedial responses to existing impairments, but TMDL regulations allow for using proactive

TMDLs to preserve existing uses. Such a TMDL would be not be difficult to develop, since the critical condition is clearly the design flow and point sources comprise most of the load under design flow conditions. It would identify the degree to which individual point sources contribute to nitrate concentrations at Little Falls under design flow conditions. Wasteload allocations would be applied as necessary to meet the target condition. Reductions need not be applied to all discharges, but could be designed around many conceivable design objectives, such as overall cost minimization.

After consulting with the TMDL-WG, the Department is not prepared at this time to address the issue of nitrate concentrations at Little Falls with a proactive TMDL. Wasteload allocations would require permit limits for all municipal treatment plants, even for those that would not require any load reduction. Furthermore, unless flow-based limits were imposed, permit limits would be applied to all flows even though the drinking water use is only threatened by nitrate during extreme low flows. Given the other departmental activities that will affect nitrate loads and given the limited scope of the nitrate threat, a TMDL may result in much more expense than is necessary to address the nitrate issue.

2. Another option considered was to not require any additional measures other than those listed above that are already underway. None of the surface waters in the Passaic River basin is listed as impaired by nitrate because there are no documented exceedances of the SWQS for nitrate. As discussed previously, nitrate levels during low-flow events have exceeded 5 mg/l on several occasions and appear to be increasing. The power regression shown in the figure above estimates that at 73 cfs (the last published MA30CD5 flow for the Passaic River at Little Falls), the nitrate concentration would be 5.7 mg/l. However, since conventional drinking water treatment does not remove nitrate and nitrate poses an acute human health risk, the protection of source water quality is critical. This option may not adequately address the need to protect the existing drinking water use over the long term.

3. One concept that has been introduced to reduce nitrate concentrations is the implementation operational denitrification. Nitrification, the biological oxidation of ammonia to nitrite and nitrate, is used by wastewater treatment plants to comply with ammonia limits. Because nitrification is an aerobic process, oxygen is pumped into the treatment plants to increase the efficiency of nitrification. Denitrification, also a biological process, is an anaerobic process whereby nitrate is reduced to nitrogen gas. Denitrification is desirable from a treatment perspective because nitrogen is converted to an inert gas and released.

   Operational denitrification essentially involves pumping less oxygen into the treatment system, creating anaerobic environments that allow for some degree of denitrification. Since less oxygen will also decrease the efficiency of nitrification, the procedure involves balancing aerobic and anaerobic conditions such that ammonia is sufficiently nitrified into nitrite/nitrate while at the same time nitrate is denitrified into nitrogen gas. Despite the savings accrued by pumping less oxygen, increased costs may be incurred due to greater sludge production, more frequent laboratory analyses, and the potential costs for violations of ammonia effluent limits.

The Passaic River Basin Alliance (PBRA, a coalition of municipal wastewater utilities) urges that nitrate reduction be addressed through operational denitrification at selected plants under emergency conditions. According to PRBA, preliminary findings from the two wastewater treatment plants where operational denitrification was demonstrated indicate that nitrogen reductions of 60% during the summer and 50% in the winter can be achieved. Operational denitrification will work in many activated sludge plants but will not work in fixed media plants. The two large plants for which operational denitrification is feasible account for 60% of the point source loading of nitrate into the Passaic, according to PRBA.

PRBA agreed to work with Passaic River Water Commission (PVWC) to develop a proposal for the Department to consider. However, PVWC expressed concern that the approaches selected, while addressing the acute nitrate concerns, may not reduce nitrate during normal flow conditions. The Department will evaluate if other measures should be taken to address the issue of nitrate concentrations at Little Falls.

NEXT STEPS

- PRBA and PVWC will work with Drought Coordination Task Force (a group formed in response to the drought of 1999 and consisting of representatives from the Department, wastewater permitees, and purveyors) to develop a specific proposal for operational denitrification.

4. Passaic River basin dynamic flow model

Water quality modeling in the Passaic River basin will be required to support several TMDL efforts. As described above in section A1, the Wanaque Reservoir TMDL will result in phosphorus allocations at the river intakes; water quality modeling in the riverine system will be required to translate the intake allocations to load and wasteload allocations in the river. Similarly, the NY/NJ Harbor TMDL for dissolved oxygen will likely result in a total nitrogen allocation in the Passaic River at Dundee Dam; riverine water quality modeling will be necessary to translate the load allocation at Dundee to load and wasteload allocations upstream in the watershed.

Water quality in the Passaic River basin is affected by complex river system hydraulics, groundwater-surface water interactions, nonpoint source runoff from mixed land uses and geologic provinces, and water quality processes in the wetlands of the Passaic River system. Because of the transient nature of the stream flows, loadings and water quality processes that need to be modeled, dynamic flow and water quality models will be required. To varying degrees, the flow and water quality models may need to simulate all of these processes or work synergistically with other models to adequately account for all significant processes. Any and all of the water quality modeling efforts in the Passaic River basin will require a transient flow model to be developed, calibrated, and validated.

To satisfy this research need, the USGS has proposed (Appendix B) to develop the hydrologic framework that will support future TMDL water quality modeling efforts in the non-tidal Passaic River basin. The research proposal, developed by USGS at the request of the Department and recommended by the TMDL-WG, included the following specific study objectives:

- Compile and evaluate wastewater discharge and surface-water withdrawal data that are needed for boundary flow conditions at the time-step needed by the transient flow model.
- Develop an accurate schematization of the Passaic River System, including a mixing algorithm to represent the mixing occurring within the vicinity of the Wanaque South withdrawal site, and use this information to construct a dynamic flow model of the system.
- Develop transient stream flow relations for tributary inflows to the Passaic River system stream reaches to be modeled (boundary conditions).
- Calibrate and validate the transient flow model using available stream-gage data and existing time-of-travel data.
- Model a 1-year period specified by the TMDL-WG to support the planned TMDL modeling.
- Prepare a water-resource investigation report to document the results of this study.

The transient flow model, mixing algorithms, and boundary flows developed as part of this project will provide the basis for future water-quality modeling efforts needed for the development of TMDLs in the non-tidal Passaic River basin. The transient flow model developed for TMDL modeling of the Passaic River system will involve advanced modeling approaches for both flow and water-quality simulations due to complex mixing at key locations within the river system, process interactions in wetlands, the transient nature of the streamflow and water-quality loadings in this basin, possible groundwater - surface water interactions, and the large number of discharges and withdrawals in the basin.

NEXT STEPS

- USGS will modify proposal as necessary to address issues raised by NJEC Review Team.
- NJEC will issue subcontract with USGS to develop flow model as proposed.

5. Meadows nutrient study

Any nutrient TMDL, whether for total nitrogen, total phosphorus or nitrate, will require relating point source discharges of nutrients to downstream water quality. The Passaic River system is complicated by the presence of wetland complexes, commonly called "meadows." It is therefore not a straightforward exercise to convert an acceptable load allocation at a point in the river to individual wasteload allocations at upstream locations. Wetland complexes might serve as a sink for loads from upstream discharges; alternatively, wetland complexes might provide a source to downstream waters that is unrelated to upstream discharges. Strom *et al*, 1989,[4] suggested that during the fall, winter and spring, Great Piece Meadows act as a source of phosphorus, but during the

[4] Strom, P.F., A. McIntosh, B.A. Rosenteel, C. Summerill. 1989. *Evaluation of Wanaque South Project with Respect to Nutrients, Toxics, and Other Selected Parameters*. Report submitted to Water Resources Division of NJDEP.

summer they act as sinks. Further research is necessary to better understand and quantify the degree to which wetland complexes in the Passaic River system act as sources and sinks of nutrients under different flow conditions.

NEXT STEPS

- NJEC will request research proposals to address this issue and assist the Department in selecting a subcontractor. The contractor will:
  - ✓ Evaluate recently published as well as ongoing wetland research projects[5] and relate as appropriate to the information gap, namely the degree to which wetland complexes in the Passaic River system act as sources and sinks of nutrients under different flow conditions;
  - ✓ design and implement a monitoring plan necessary to better understand and quantify the degree to which wetland complexes in the Passaic River system act as sources and sinks of nutrients under different flow conditions.; and
  - ✓ apply results to develop water quality models for the rivers that would capture the essential wetland processes.

6. Nutrient/Biological dynamics study

Concern has been raised that significant changes in the nutrient loads to the Passaic system, either increases or decreases, may have unforeseen negative impacts on the existing biological communities. Primary production in the Passaic mainstem and major tributaries appears not to be limited by nutrients under most conditions, meaning that increases or decreases in allochthonous nutrient loads will not greatly alter the overall primary productivity in the rivers. However, there are other mechanisms whereby nutrients can exert impacts on plankton, benthos, and fisheries. For instance, the worst algal blooms in the Pompton River occur when algal community composition shifts during brief periods of nitrogen limitation. The Passaic and Pompton Rivers appear to experience quite different nutrient kinetics. Research is needed to examine the physical, chemical and biological properties of the Passaic and Pompton Rivers to better understand and quantify the nutrient kinetics and biological dynamics that occur in each system, including the role of sediments. The first phase would characterize the physical, chemical and biological structure of the Passaic and Pompton Rivers at several locations upstream and downstream of the confluence. Results of the first phase would be used to develop water quality models for the respective rivers that would capture the essential processes. As discussed above in sections A1 and A4, water quality modeling of these rivers is a critical component of several TMDL efforts.

NEXT STEPS

- NJEC will request research proposals to address this issue and assist the Department in selecting a subcontractor. The contractor will:

[5] Wetland research is managed by the Division of Science, Research and Technology (http://www.state.nj.us/dep/dsr/wetlands/index.htm).

- ✓ design and implement a monitoring plan necessary to characterize the physical, chemical and biological structure of the Passaic and Pompton Rivers at several locations upstream and downstream of the confluence; and
- ✓ apply results to develop water quality models for the respective rivers that would capture the essential processes.

B. Fecal Coliform

1. upstream of CSOs

Upstream of the combined sewer overflows (CSOs) in the City of Paterson, fecal coliform is generally considered to be a nonpoint source issue. Municipal point source effluents, while potentially important sources of fecal contamination, in practice contribute very little to fecal contamination due to effective treatment and disinfection. Municipal wastewater discharges are required to meet stream criteria for fecal coliform in the effluent. Nonpoint sources of fecal coliform are strongly influenced by land use and mostly driven by rainfall, although failing septic systems and inflow/infiltration within sanitary sewers can be important sources in some areas.

NEXT STEPS

- The Department will develop a statewide technical approach for addressing pathogen indicator impairments in areas not affected by CSOs, as discussed below under Statewide Issues. This approach will then be applied to the non-tidal Passaic River basin upstream of Paterson.

2. dynamic receiving water model for non-tidal CSO area (Paterson to Dundee)

The non-tidal Passaic River from the City of Paterson to Dundee Dam in the City of Clifton receives multiple discharges from combined sewer overflows. The influence of CSOs adds a level of complexity that warrants analyzing this portion of the Passaic River basin separately from the upstream watersheds. The analysis will have to incorporate flow and water quality information as well as upstream management actions, including TMDLs. In order to satisfy requirements of the CSO control program, monitoring and modeling studies using Storm Water Management Model (SWMM) are being conducted, the results of which will be able to dynamically simulate flow and water quality discharging from CSOs into the Passaic River.

A dynamic flow and receiving water quality model of the Passaic River from Paterson to Dundee must be developed. The receiving water model must be capable of incorporating SWMM output from CSOs, upstream boundary conditions, and point source discharges, including stormwater. In addition to fecal coliform, the model must be able to simulate phosphorus and nitrogen in order to support possible TMDL needs discussed previously.

NEXT STEPS

- NJEC will request research proposals to address this issue and assist the Department in selecting a subcontractor. The contractor will:

- ✓ determine additional data necessary to develop and calibrate the model, and design and implement a monitoring plan accordingly; and
- ✓ develop and calibrate dynamic flow and receiving water quality model of the Passaic River from Paterson to Dundee as described above.

C. Statewide issues

1. application of phosphorus criteria

As stated above under Current Status, the Department is working to clarify the relationship between nutrient policies, nutrient criteria and designated use attainment. Assessments of oxygen dynamics, primary production, sedimentation, and downstream impacts will be used as appropriate to evaluate the current and future needs for phosphorus management in the non-tidal Passaic River basin. As needed, the Department will develop site-specific nutrient criteria to address confirmed designated use impairments. Also, it is anticipated that a statewide technical approach will be developed and presented to NJEC for review.

2. statewide TMDL response to pathogen indicators

Fecal coliform loads and concentrations can vary many orders of magnitude from one place to another and over time at a single location, making dynamic model calibrations very difficult. Furthermore, in areas not affected by CSOs, fecal coliform is primarily a nonpoint source issue, although inputs of human waste from failing sewage conveyance systems and failing or inappropriately placed septic systems must be evaluated. Control options available to address nonpoint sources of fecal coliform include measures such as goose management strategies, pooper-scooper ordinances, and septic system maintenance; the efficacy of such control measures is not known to a fine degree of accuracy. Given these considerations, detailed water quality modeling may not provide any additional insight or guidance toward the development of implementation plans to reduce fecal coliform sources.

The Department will therefore develop a statewide approach to dealing with fecal coliform impairments in waters not affected by CSOs. The approach will make use of modeling only as necessary and helpful toward developing implementation plans that will address the impairment and satisfy the applicable TMDL requirements. The approach will also involve innovative source characterization monitoring (e.g. Multiple Antibiotic Resistance, coliphage serio-typing). The Department will present this statewide approach for addressing pathogen indicator impairments to NJEC for review.

III. Appendix A

DRAFT

TMDL Development Plan for Lead (Pb) in the Whippany River

A Joint Technical Discussion Paper Developed by EPA Region II and
NJ Department of Environmental Protection (NJDEP)

September 24, 2001
(see file "PRB Appendix A.doc")

IV. Appendix B Proposal to model flow in Passaic River basin riverine system

(draft proposal in file "PRB Appendix B.doc"
under revision, to be finalized by end of October, 2001)